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Information Systems Control: A Review and Synthesis of the Literature

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ABSTRACT

The control of information systems (IS) activities has an extensive research history, ranging from early views on the management of systems development projects to more recent examinations of technology outsourcing. Using a structured methodology, 48 control-related articles from a range of IS journals are examined and individually coded. Based on patterns emerging from the literature, a comprehensive framework of IS control research is presented. The study's findings reveal opportunities for future research, including the use of a wider range of research methodologies and epistemologies, an expanded focus beyond project level controls, and the creation of innovative conceptualizations of IS control that better reflect the realities of technology in today's organizations.

Keywords

Information systems control, IT management, IT governance.

INTRODUCTION

Organizations seek to achieve a range of objectives related to the operation of information systems, ranging from cost reduction to innovation and information quality to regulatory compliance. In order to motivate employees to achieve these goals, control mechanisms are used to intentionally affect the behavior of individuals and groups (Davis, 1940; Flamholtz, Das and Tsui, 1985; Tannenbaum, 1962). For nearly a century, researchers have studied organizational control processes, including the unique aspects of control within the disciplines of marketing, strategy, and accounting. More recently, technological advancements have stimulated a growing interest in information systems control issues as organizations continue to struggle with how best to achieve their technology-related objectives (Harris, Collins and Hevner, 2009; Rao, Brown and Perkins, 2007).

Today's organizations are increasingly concerned with the challenges of managing IT processes where participants are distributed across global locations (e.g. virtual teams, offshoring), work on interdisciplinary initiatives (e.g. enterprise applications), represent external third parties (e.g. outsourcing), or act in a volunteer capacity (e.g. crowdsourcing) (Faraj and Xiao, 2006). The field of information systems has accumulated a distinct and valuable collection of literature related to the control of technology-related activities that can aid organizations in addressing these challenges. However, the literature is diverse and has neither been synthesized into a useful framework that can be analyzed and interpreted by practicing managers, nor has it been comprehensively analyzed for the academy in order to identify gaps and areas for future inquiry.

This literature review examines the unique aspects of control within the field of information systems. Two key contributions will be made. First, the core aspects of the IS control process will be formalized and key relationships between concepts will be synthesized into a comprehensive framework, based on past research findings. Second, the analysis of the literature will identify a series of gaps that offer a basis for future research directions.

The paper is organized as follows. First, a brief overview of IS control is presented. This will be followed by a description of the methodology employed in this study and the resulting research framework. Highlights of the IS control literature will then be discussed, noting the unique concepts and themes. Finally, the study's implications and opportunities for future research will be outlined.

INFORMATION SYSTEMS CONTROL

In defining IS control, I build on past views of organization control from commentators such as Ouchi (1977) and Tannenbaum (1962), as well as consider the boundaries of the information systems field as defined by Ives, Hamilton and Davis (1980). As such, IS control is uniquely defined as the process of a person or group attempting to affect the behavior of another person or group, as a means to achieve objectives related to the development, operation and use of information systems. This conceptualization includes both managerial methods of controlling individual and group behavior (e.g.

monitoring subordinate output, implementing a policy or procedure), as well as technical methods (e.g. information security mechanisms, such as passwords). That is, IS control encompasses not only the internal controls embedded within technology tools, but also the managerial techniques used to influence employees to act in accordance with IS aims. This definition is consistent with past views of IS control that refer to the topic in a behavioral and technical sense (e.g. Orlikowski, 1991). IS control focuses on the relationship between the behavior of organizational actors as they conduct their day-to-day activities and the pursuit of IS objectives (Kirsch, 1997). Specifically, past research has examined IS control as it relates to activities such as IS development projects (e.g. Kirsch, 1997), global systems (Kirsch, 2004), outsourcing (Choudhury and Sabherwal, 2003), open source activities (Stewart and Gosain, 2006), and information security (e.g. Boss, Kirsch, Angermeier, Shingler and Boss, 2009). On this basis, IS control is considered to be related to, but distinct from, topics such as IT governance, which focus primarily on decision rights and accountabilities related to IS at a senior management level (Weill, 2004) rather than attempts to influence the more wide-ranging behavior of both senior and junior employees conducting IS activities.

LITERATURE REVIEW

Methodology

An initial literature search spanning three prominent information systems journals was performed: MIS Quarterly, Information Systems Research, and the Journal of Management Information Systems. For each of these three journals, an electronic search was conducted for the term 'control' in the title and abstract of all published articles. The results were individually reviewed to determine if the article's topic was consistent with the IS control definition noted above. Those articles focusing exclusively on the control of an object (e.g. system, application) from an engineering perspective were viewed as being beyond the scope of the review and were not included. Both empirical and theoretical pieces were considered eligible for inclusion in the study. A total of 150 articles were identified from the search; 30 of these met the review criteria.

The second step of the methodology was to review the selected articles for references to other IS control publications. Where a potential article of interest was referenced, it was obtained and reviewed; if the new article met the study criteria, it was included in the review. This follows Webster and Watson's (2002) suggestion to identify previous publications when conducting a literature review. An additional 18 publications were identified from journals including the European Journal of Information Systems, Information Systems Journal, and Organization Science, for a total of 48 articles. Articles included in the review are highlighted in the References section with an asterisk (*).

IS Control Framework

A preliminary framework for evaluating the research on IS control, inspired by the work of Powell, Piccoli and Ives (2004), was established early in the literature review process and was iteratively refined over the course of the study. Five primary control concepts were identified from the literature: control environment, control features, control execution, socio-emotional experiences, and control outcomes (see Figure 1).

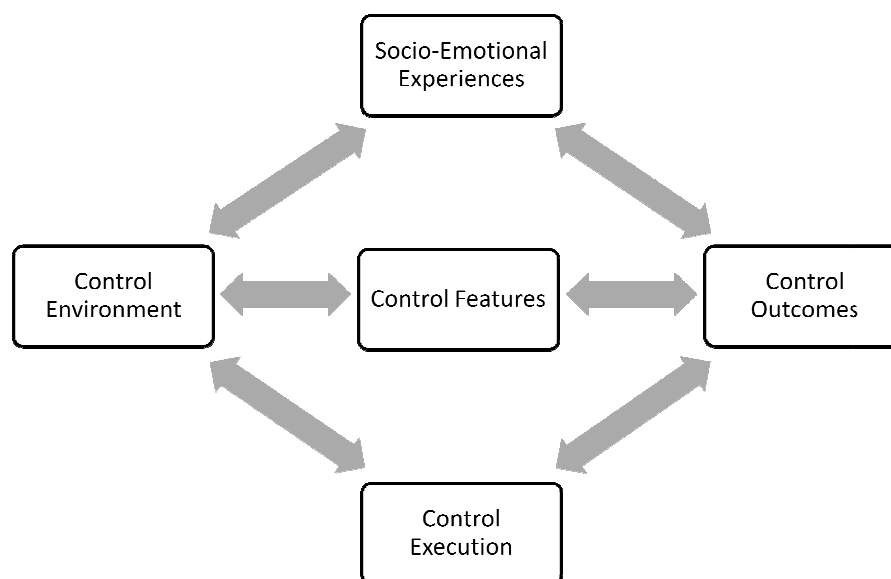


Figure 1. Framework of IS Control Research

Each concept consists of a series of underlying themes that emerged during the review. The concepts and themes are not based on a pre-existing theory of control, but are grounded in the patterns of ideas and empirical results that form the literature in the field. Taken together, this framework represents a collection of the unique topics that the literature suggests are relevant to IS control processes within organizations.

RESULTS

Each of the 48 papers included in the review was coded to as many control concepts and underlying themes as was applicable (i.e. a paper could include multiple control themes). Where relationships were theorized or empirically evaluated between two inter-concept themes within a paper, this was also coded. A total of 34 papers were found to be applicable to the control environment theme, 25 to the control features theme, 13 to the control execution theme, 12 to the socio-emotional experiences theme, and 32 to the control outcomes theme. Details of the five emergent control concepts and underlying themes are described below, including a selection of representative examples from the literature.

Control Environment

The control environment concept represents the range of organizational factors that can influence the choice of a particular IS control. Five themes are identified in the literature as being the primary determinants of IS control choice: strategy, structure, process, culture, and people.

The strategy theme refers to the influence that the business and IT strategy employed within an organization has on IS controls. Research suggests that the approach to competitive differentiation and the unique role played by a company's divisions can influence what IS controls are implemented. For example, Orlikowski (1991) finds that corporate strategies advocating consistent, quality service contribute to the increased use of formal systems development methodologies as a control mechanism. Similarly, Kellogg, Orlikowski and Yates (2006) find that organizational demands for internal flexibility and speed can influence the design of oversight activities. Finally, depending on the strategic role of overseas subsidiaries (Rao et al., 2007) or the maturity of the IT application strategy (Duh, Chow and Chen, 2006), the type of control mechanisms employed may be different.

The structure theme refers to the organizational and/or project structure characteristics that relate to the types of control chosen. Though past research argues that control is fundamentally different than structure (Ouchi, 1977), the IS control literature suggests that the two concepts are closely related. The organizational structure is seen to influence IS control processes (Karimi and Konsynski, 1991), as well as the specific structure of the associated IT project (McFarlan, 1981). A recent focus of IS control research related to structure addresses the sourcing arrangement for IS activities. Research has found that internally sourced IS initiatives are associated with different types of controls than are outsourced initiatives (Tiwana and Keil, 2009).

The process theme refers to the characteristics of an IS process that influence the choice of controls. A key focus of the research is on the degree of behavior observability and the outcome measurability of the processes being undertaken. Behavior observability is found to relate to increased behavior and outcome control; outcome measurability is found to relate to reduced self control and increased outcome control (Kirsch 1996). Later research finds that these relationships are contingent on the internal versus external nature of the IS initiative, as well as the client's knowledge of the process (Kirsch, Sambamurthy, Ko and Purvis, 2002).

The culture theme refers to the national or organizational culture characteristics that influence the choice of IS controls. Past research has suggested that characteristics including ideology and geography can influence the choice of particular controls (Kirsch, 2004). For example, cultures valuing formality are more likely to influence the selection of outcome rather than self-control (Kirsch et al., 2002). From an organizational perspective, Orlikowski (1991) finds that workers internalize the assumptions, values, and interests of the organization and culture becomes indoctrinated into employees via IT-enabled control. Control mechanisms such as systems development methodologies and IT productivity tools are designed to echo an organization's values and interests; when used by employees, the control becomes embedded in an organization's culture.

The people theme refers to how a controller or controlee's role, knowledge, or social capital can influence the choice of IS control. Although most IS control research focuses on IS experts like developers or IT managers, others look at how technology is used to control the behavior of other professionals, such as scientists (Cardinal 2001) and physicians (Kohli and Kettinger, 2004). Past research has suggested that the context surrounding a controller or controlee's role (e.g. required skills, anticipated goals) can influence the creation of IS controls (Kirsch, 1997).

Control Features

The control features concept represents the core characteristics of the IS controls selected for implementation. Two themes are identified: control categories and control mechanisms.

The control category theme refers to logical groupings of controls with similar characteristics. The most dominant theme in the literature uses the categorization of control modes (i.e. behavioral, outcome, clan, self), such as Kirsch (1996, 1997). However, some publications including Gopal and Sanders (1997) and Tiwana and Keil (2009) utilize distinct categorizations of control characteristics (e.g. preventative/deterrent controls, attempted/realized controls).

The control mechanism theme refers to a particular activity or tool that influences the behavior of individuals or groups in a focused manner. Research literature in this theme focuses on the selection of a particular mechanism, ranging from security policies and procedures (Boss et al. 2009) to development methodologies (Fitzgerald 1996; Orlikowski 1991) to software testing tools (Helms & Weiss 1986; Phan et al. 1995).

Control Execution

The control execution concept represents the issues related to the carrying out, evolution, and operational side-effects of implemented controls. Two themes are identified: control effectiveness and control changes over time.

The control effectiveness theme refers to the perceived value of an implemented control. Studies focusing on this theme commonly relate a control's effectiveness to the anticipated realization of organizational outcomes. In cases where control is deemed insufficient, performance issues are predicted, including systems development failures (Kraut and Streeter, 1995) and limited cost reductions (Sia and Neo, 1997). When a particular control or collection of controls is considered to be inadequate, additional controls are commonly added (Choudhury and Sabherwal, 2003).

The control changes theme refers to the incremental adjustments that occur to controls as a result of their ongoing use, interpretation, and adaption by controllers and controlees. One line of inquiry in this theme considers changing controls to be the result of controller-controllee interactions. Choudhury and Sabherwal (2003) suggest that changes in control over time can be attributed to the ongoing interactions between outsourced software development clients and vendors over the course of a project, which can influence the motivations for choosing a control in the first place (i.e. the control environment). Similarly, Kohli and Kettinger (2004) find that when control mechanisms are newly introduced or revised, their validity is either rejected or strengthened within clans of controlees based on a set of shared values. These shared values can change normative expectations, which can lead to revised control expectations.

Socio-Emotional Experiences

The socio-emotional experiences concept represents the social and emotional implications that occur in relation to chosen or operating IS controls. Three themes are identified: motivation and satisfaction, psychological and cognitive structures, and socialization.

The motivation and satisfaction theme refers to the intrinsic and extrinsic motivations of an individual or group to participate on an information systems initiative, as well as their satisfaction with the initiative as it relates to IS control. When an IS activity or tool is seen to slow or obstruct an employee's work, they may choose to not use it, thus undermining the effectiveness of the embedded control mechanism (Orlikowski, 1991). However, intrinsic and extrinsic motivations can influence an individual's participation on an IS initiative, which can work to reinforce the related controls (Roberts, Hann and Slaughter, 2006). Interestingly, Santana and Robey (1995) find that IS professionals' perceptions of managerial control, team-member control, and self control within an IS initiative relates to a significant and positive relationship with general satisfaction.

The psychological structures theme refers to a change in an individual's psychological state stemming from the existence of IS controls. Early work on this theme uncovered that the implementation of information systems could lead to a perceived lack of self, which could result in stress, uncertainty, and discomfort (Olson, 1982). This theme was further developed in later work, which suggested that the employment of IS controls could be associated with the oppression of employees. For example, Orlikowski (1991) argues that as a control mechanism, development methodologies can become embedded in the thinking of workers, to the extent that it can "diminish the potential for workers to reflect on their action" (Orlikowski, 1991, p. 35).

The socialization theme refers to the interactions and relationships between or within controller and controllee groups that influence the effectiveness, choice, or perceived performance of controls. Socialization is seen to encourage employees to internalize the organization's assumption and beliefs as a means to influence shared norms through the use of particular vocabulary, images, and relations in order to understand the norms of behavior (Orlikowski, 1991). On a team level, core

values, norms, and beliefs of the group will influence the communication quality, trust, and expectations of the team (Stewart and Gosain, 2006).

Control Outcomes

The control outcomes concept represents the degree that particular organizational objectives are pursued and/or achieved for which the IS controls were implemented. Six themes are identified: quality, profit/cost, speed/schedule, innovation, risk reduction, and compliance.

The quality theme refers to the relationship between process or product quality and IS controls. Quality is a fundamental driver of control and is widely examined in the IS literature. The quality of software is the primary focus, as investigated by studies such as Maruping et al. (2009). Though process quality is examined to a lesser extent, studies such as Jiang, Klein, Hwang, Huang and Hung (2004) address the topic in relation to the software process maturity.

The profit and cost monitoring theme refers to the relationship between IS controls, maximized profits, and minimized costs. The literature addressing this theme primarily examines how IS control can be used to monitor and control budgeted costs and expected profits (e.g. Helms and Weiss, 1986).

The speed and schedule achievement theme refers to the relationship between control and the timeliness of an IS initiative. The literature addressing this theme focuses on efficiency issues in order to increase the speed of IS activities such as systems development (e.g. Jiang et al., 2004).

The innovation theme refers to the relationship between IS control and the degree of innovation generated by IS activities. Work by Orlikowski (1991) and Fitzgerald (1996) argues that control can constrain workers, stifle the creative process, and limit adaptability. However, Cardinal (2001) considers how control can influence both radical (i.e. major changes in technology) and incremental (i.e. minor changes in technology involving small advances) innovations. Interestingly, she finds behavior and output control are associated with enhanced radical innovation, while input and output control are associated with enhanced incremental innovation.

The risk reduction theme refers to the relationship between IS controls and the existence of business and technology risks. These risks originate from such sources as information security (Boss et al., 2009; Spears and Barki, 2010), systems development projects (Baskerville and Stage, 1996), and piracy (Gopal and Sanders, 1997).

The compliance theme refers to the verification and fulfillment of relevant external (e.g. legal rules) or internal (e.g. management policies) regulations, such as those established related to auditing and accounting. Recent legislation such as Sarbanes-Oxley is considered (Spears and Barki, 2010), as well as more general objectives of complying with audit standards and management policies (Jiang et al., 2004; Rittenberg and Purdy, 1978).

OPPORTUNITIES FOR FUTURE RESEARCH

The review of IS control literature outlined above highlights a series of concepts and themes from research within the field. This section will briefly outline the resulting implications and opportunities for research and practice.

Alternative Methodologies and Epistemologies

The results of this literature review highlight the diverse range of IS control research and patterns regarding how these topics are investigated. Table 1 illustrates the methodologies associated with papers in each of the five control concept categories.

Methodology	Control Environment	Control Features	Control Execution	Socio-Emotional Experiences	Control Outcomes
Survey	18	14	4	4	18
Case Study	9	6	8	4	7
Archival	3	2	0	1	4
Theoretical	3	2	0	1	3
Action Research	2	1	1	1	1
Experiment	0	0	0	2	0

Table 1. Methodologies Used in the Study of IS Control

As noted, the survey and case study approaches are particularly popular in each grouping, while the remaining four methods are only used sporadically. The avoidance of utilizing a more balanced selection of research methods may limit opportunities to identify novel insights related to IS control phenomena. Similarly, it is noted that the vast majority of IS control literature is approached from a positivist epistemology. Very few researchers have examined IS control issues from an interpretivist or critical perspective (exceptions include Kirsch, 2004; Orlikowski, 1991; and Silva and Hirschheim, 2007). A key opportunity for future research in IS control is to adopt alternative research methods (e.g. ethnography) and epistemologies as a means to approach the topic from a new perspective.

Expanded Topic Breadth and Advanced Control Topics

The overwhelming majority of studies on IS control investigate discrete project activities, typically in the context of software development and outsourcing. An opportunity exists to expand the focus of IS control research to go beyond a project focus and examine the larger departmental and organizational control issues. For example, IS control research could consider how the emerging technology processes and tools (e.g. cloud computing, ubiquitous computing, social computing) being employed in today's organizations are being controlled.

The findings from this review also highlight that only limited research has been conducted in relation to socio-emotional experiences and control execution concepts. Future research could attempt a more comprehensive examination of the motivational, psychological, and socialization structures related to the employment of IS control. In addition, future research related to control execution could consider adopting longitudinal and retrospective studies in order to consider the temporal issues related to control that have largely been avoided in the research to date.

CONCLUSION

Information systems control is an important topic within the field and has generated a significant collection of publications. This study has comprehensively reviewed the literature, proposed a framework that articulates its fundamental elements, and then highlighted gaps in past research in order to offer a basis for future research directions.

Past IS research has focused most heavily on the concepts of control environment, control features, and control outcomes, but has also considered the processes related to the execution of control and the socio-emotional experiences of employees resulting from control. A number of future opportunities in the study of IS control are presented, including broadening the methodologies and epistemologies employed, expanding the IS control topics beyond a project focus, and enhancing new, innovative conceptualizations of IS control that better reflect the realities of technology in today's organizations.

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